Central Places of Transit Riders: A Visual Story of Brisbane, Australia

Ming Wei & Jiangping Zhou

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**ABSTRACT**

This study uses smartcard data to quantify and visualize the most popular destinations ('central places') and corridors of transit riders in Brisbane, an emerging global city in Queensland, Australia. It shows that the number and distribution of central places vary significantly across different periods of the day and so are their respective scopes of influence, which are measured by a standard deviational ellipse, and the associated transit corridors, which connect visitors of central places to other locales in the city. As a whole, this study shows the potential of smartcard data in efficiently verifying and even extending existing economic geography theories, models or concepts.

**ARTICLE HISTORY**

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**KEYWORDS**

Smartcard data; central place; head - tail algorithm; Brisbane; transit

Central place theory, which was developed in 1933, has considered cities as ‘central places’ providing services and goods for some number of residents/customers and proposes that central places could have their respective hexagonal territories (Goodall, 1987). This theory forms an important basis for one to understand cities and associated spatial hierarchies (Openshaw & Veneris, 2003). Delineating and visualizing central places and their hierarchies has not been an easy task when we use data from traditional sources such as household surveys or face-to-face interviews, which are often times a small sample of the population.

Data based on smartcard swipes over five consecutive weekdays (March 11–15, 2013) from Brisbane in Queensland, Australia, were use to visualize ‘central places’ of local transit riders, which are regarded as the stations that attract the most transit riders on different periods of a day. Here, the use of a smartcard is so popular that over 90% of local transit riders tap on and off each time they make a transit trip. This generates rich information source about local transit riders such as their trip origins, destinations and route choice. The information enables us to identify and visualize ‘central places’ of the riders, their associated route choice (transit corridors), trip origins and standard deviational ellipse (SDE) on different periods of a day: morning peak (07.00–10.00 hours), off peak (10.00–16.00 hours), afternoon peak (16.00–19.00 hours) and night hours (19.00–23.00 hours) (Figure 1).

In Figure 1, we treat the level 1–3 stations (heads) that attract the most transit riders as the central places (red, blue and green dots). Different levels of stations are defined based on the...
head–tail algorithm developed by Jiang (2013, p. 482), which ‘partitions all of the data values around the mean into two parts and continues the process iteratively for the values (above the mean) in the head until the head part values are no longer heavy-tailed distributed’. The algorithm

Figure 1. Central places of transit riders.
also generates an h–t index, which represents the number of partitions with which the iteration ends. The width of different transit routes (orange lines) represents the volume of transit riders. The density map of the origins of these riders serves as the background, which ranges from light to deep black. The darker is the colour, the higher is the density. SDEs are shown in cyan (blue), which cover all the stations that attract 68% of the transit riders.

The visuals indicate that the number and distribution of central places vary significantly across different periods of a day and so are their respective SDEs. Somehow, to our surprise, the route choice of transit riders and corresponding passenger volumes in the morning and afternoon peaks vary rather than resemble each other. Many routes tend to be more congested in the afternoon peak. The night hours produce a larger SDE than the off-peak hours. As a whole, the visuals more or less show why it is so challenging (probably also costly) to maintain a quality transit system to satisfy the mobility demand of residents, who come from numerous origins and travel to different destinations across periods and the popularity of most routes of transit riders vary significantly over time too.

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**ORCID**

Jiangping Zhou [http://orcid.org/0000-0002-1623-5002](http://orcid.org/0000-0002-1623-5002)

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